Contribution ID: **22** Type: **poster**

Accurate Simulation of the Finite Density Thirring Model

Monday, 26 June 2017 17:20 (0 minutes)

We present a study of the finite density lattice Thirring model in 2 dimensions using the world-line/fermion-bag algorithm. The model has features similar to QCD and provides a test case to explore the accuracy of various methods to solve sign problems. In the massless limit and with open boundary conditions we show that the sign problem is an artifact of the auxiliary field approach and is completely eliminated in the world-line approach. With anti-periodic boundary conditions the sign problem is mild on square lattices in the fermion bag method. We present accurate results for various quantities in the model that can be used as a benchmark for comparison with other methods of solving sign problems.

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Session Classification: Poster session